CLAIMS

What is claimed is:

1. A high power diode laser system having narrow spectral width output comprising:

(a) a high power diode laser that produces multimode laser light output at power levels of at least one watt and having a relatively broad spectral range;

(b) a collimating element positioned to receive the output of the laser diode and provide a collimated output beam; and

(c) a diffraction grating mounted to receive the collimated beam from the collimating element on a beam path, the diffraction grating oriented at an angle to the incident beam such that a portion of the light in the beam incident on the grating is directed back on the beam path to the collimating element and is focussed on the diode laser to provide feedback thereto to narrow the spectral range of the laser light output.

2. The laser system of Claim 1 including a polarization rotation element in the beam path from the collimating element to the diffraction grating, the polarization rotation element oriented such that the light on the beam path passed therethrough to the diffraction grating is oriented with respect to the diffraction grating to provide a selected efficiency of the diffraction grating and to select the amount of light directed back by the diffraction grating toward the diode laser to provide effective feedback without damaging the diode laser.

3. The laser system of Claim 2 wherein the polarization rotation element is mounted for rotation to allow rotation of the polarization rotation element to select the amount of feedback to the diode laser.

4. The laser system of Claim 3 wherein the polarization rotation element is a half wave plate.

5. The laser system of Claim 2 wherein the polarization rotation element is a half wave plate.

6. The laser system of Claim 1 further including a compensating lens mounted to compensate for astigmatism in the output light from the diode laser.

7. The laser system of Claim 1 wherein the collimating element comprises a spherical lens.

8. The laser system of Claim 1 wherein the diode laser provides two spatially diverging output beams on two beam paths, wherein there are two diffraction gratings, each mounted to intercept the beam on one of the beam paths, the gratings partially reflecting the beam on each beam path back on the beam path through the collimating lens to focus the light back onto the position in the diode laser from which the light on that beam path originated.

9. The laser system of Claim 8 including a polarization rotation element mounted in each of the two beam paths to control the amount of feedback from the gratings to the diode laser.

10. The laser system of Claim 1 wherein the diode laser provides two spatially diverging output beams on two beam paths from two active regions, and including a cylindrical lens positioned in the beam path between the collimating element and the diffraction grating, the cylindrical lens formed and positioned to image the output of the diode onto the grating, the first order diffraction feedback from the grating directed by the cylindrical lens and collimating element back to the diode laser to form an image of the diode output such that each of the two diode active regions is imaged back onto itself.

11. The laser system of Claim 1 wherein a portion of the beam incident on the diffraction grating is directed by the diffraction grating to provide a useable output light beam from the laser system.

12. The laser system of Claim 1 including a beam splitter in the beam path between the collimating element and the diffraction grating, the beam splitter partially reflecting the light from the array to provide a useable output beam from the system and partially passing the light therethrough to the diffraction grating and thence back again to be focussed onto the emitter in the diode layer.

13. A method of narrowing the spectral width of the output of a high power diode laser that produces multimode laser light output at power levels of at least one watt having a relatively broad spectral range, comprising:

(a) receiving the output of the diode laser with a collimating element to provide a collimated output beam; and

(b) directing the collimated output beam to a diffraction grating mounted to receive the collimating beam from the collimated element on a beam path, and directing a portion of the beam from the grating back on the beam path to the collimating element and focusing the beam on the diode laser to provide feedback thereto to narrow the spectral range of the laser light output.

14. The method of Claim 13 including selecting the amount of light directed back by the diffraction grating to the diode laser to provide effective feedback without damaging the diode laser by passing the light on the beam path through a polarization rotation element.

15. The method of Claim 14 further including rotating the polarization rotation element about an axis parallel with the output beam from the collimating element to select the amount of feedback to the diode laser.

16. The method of Claim 15 wherein the polarization rotation element through which the light is passed is a half wave plate.

17. The method of Claim 13 further including the step of passing the output light beam from the diffraction grating into a cell containing a gas sample to laser polarize the gas.

18. The method of Claim 17 wherein the gas is selected from the group consisting of xenon, helium, mixtures of xenon and rubidium, mixtures of helium and rubidium, mixtures of cesium and xenon, and mixtures of potassium and helium.

19. The method of Claim 13 including directing a portion of the beam from the diffraction grating to provide a useable output light beam.

20. A high power diode laser system having narrow spectral width output comprising:

(a) a high power diode laser that produces multimode laser light output at power levels of at least one watt and having a relatively broad spectral range;

(b) a collimating element positioned to receive the output of the laser diode and provide a collimated output beam; and

(c) a diffraction grating mounted to receive the collimated beam from the collimating element on a beam path and a mirror facing the grating, the diffraction grating oriented at an angle to the incident beam such that a portion of the incident beam is directed by the diffraction grating to the mirror and back and a portion of the light is directed back on the beam path to the collimating element and is focussed on the diode laser to provide feedback thereto to narrow the spectral range of the laser light output.

21. The laser system of Claim 20 including a polarization rotation element in the beam path from the collimating element to the diffraction grating, the polarization rotation element oriented such that the light on the beam path passed therethrough to the diffraction grating is oriented with respect to the diffraction grating to provide a selected efficiency of the diffraction grating and to select the amount of light directed back by the diffraction grating toward the diode laser to provide effective feedback without damaging the diode laser.

22. The laser system of Claim 21 wherein the polarization rotation element is mounted for rotation to allow rotation of the polarization rotation element to select the amount of feedback to the diode laser.

23. The laser system of Claim 22 wherein the polarization rotation element is a half wave plate.

24. The laser system of Claim 21 wherein the polarization rotation element is a half wave plate.

25. The laser system of Claim 20 further including a compensating lens mounted to compensate for astigmatism in the output light from the diode laser.

26. The laser system of Claim 20 wherein the collimating element comprises a spherical lens.

27. The laser system of Claim 20 wherein the diode laser provides two spatially diverging output beams on two beam paths, wherein there are two diffraction gratings, each mounted to intercept the beam on one of the beam paths, the gratings partially reflecting the beam on each beam path back on the beam path through the collimating lens to focus the light back onto the position in the diode laser from which the light on that beam path originated.

28. The laser system of Claim 27 including a polarization rotation element mounted in each of the two beam paths to control the amount of feedback from the gratings to the diode laser.

29. The laser system of Claim 20 wherein the diode laser provides two spatially diverging output beams on two beam paths from two active regions, and including a cylindrical lens positioned in the beam path between the collimating element and the diffraction grating, the cylindrical lens formed and positioned to image the output of the diode onto the grating, the first order diffraction feedback from the grating directed by the cylindrical lens and collimating

element back to the diode laser to form an image of the diode output such that each of the two diode active regions is imaged back onto itself.

30. The laser structure of Claim 20 wherein a portion of the beam incident on the diffraction grating is directed by the diffraction grating to provide a useable output light beam from the laser system.

31. The laser system of Claim 20 including a beam splitter in the beam path between the collimating element and the diffraction grating, the beam splitter partially reflecting the light from the array to provide a useable output beam from the system and partially passing the light therethrough to the diffraction grating and thence back again to be focussed onto the emitter in the diode layer.

32. A method of narrowing the spectral width of the output of a high power diode laser that produces multimode laser light output at power levels of at least one watt having a relatively broad spectral range, comprising:

(a) receiving the output of the diode laser with a collimating element to provide a collimated output beam; and

(b) directing the collimated output beam to a diffraction grating mounted to receive the collimating beam from the collimated element on a beam path, reflecting light from the diffraction grating by a mirror back to the diffraction grating, and directing a portion of the beam from the grating back on the beam path to the collimating element and focusing the beam on the diode laser to provide feedback thereto to narrow the spectral range of the laser light output.

33. The method of Claim 32 including selecting the amount of light directed back by the diffraction grating to the diode laser to provide effective feedback without damaging the diode laser by passing the light on the beam path through a polarization rotation element.

34. The method of Claim 33 further including rotating the polarization rotation element about an axis parallel with the output beam from the collimating element to select the amount of feedback to the diode laser.

35. The method of Claim 34 wherein the polarization rotation element through which the light is passed is a half wave plate.

36. The method of Claim 32 further including the step of passing the output light beam from the diffraction grating into a cell containing a gas sample to laser polarize the gas.

37. The method of Claim 36 wherein the gas is selected from the group consisting of xenon, helium, mixtures of xenon and rubidium, mixtures of helium and rubidium, mixtures of cesium and xenon, and mixtures of potassium and helium.

38. The method of Claim 32 including directing a portion of the beam from the diffraction grating to provide a useable output light beam.